



High energy radiation profile of Jupiter as observed by the JunoASC

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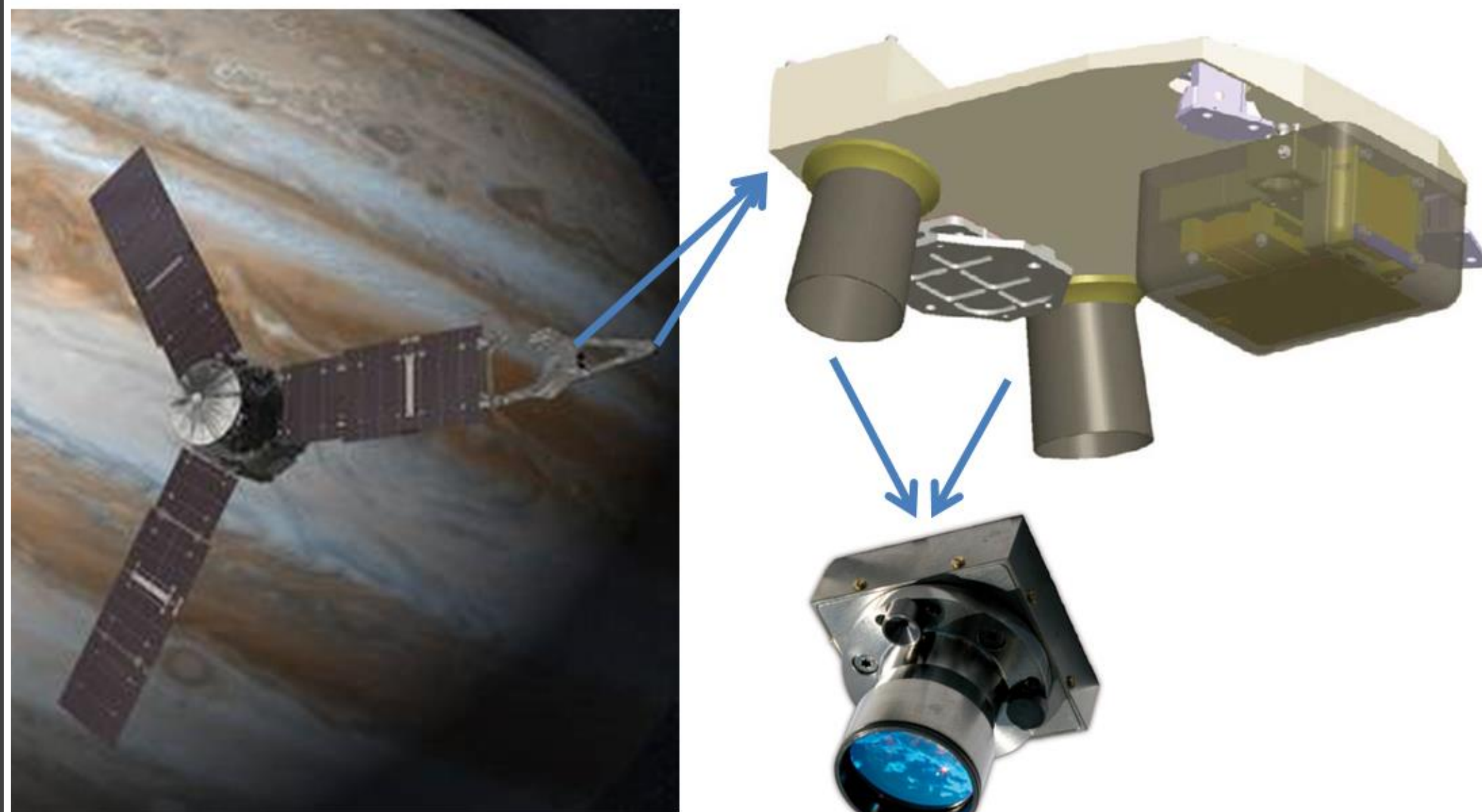
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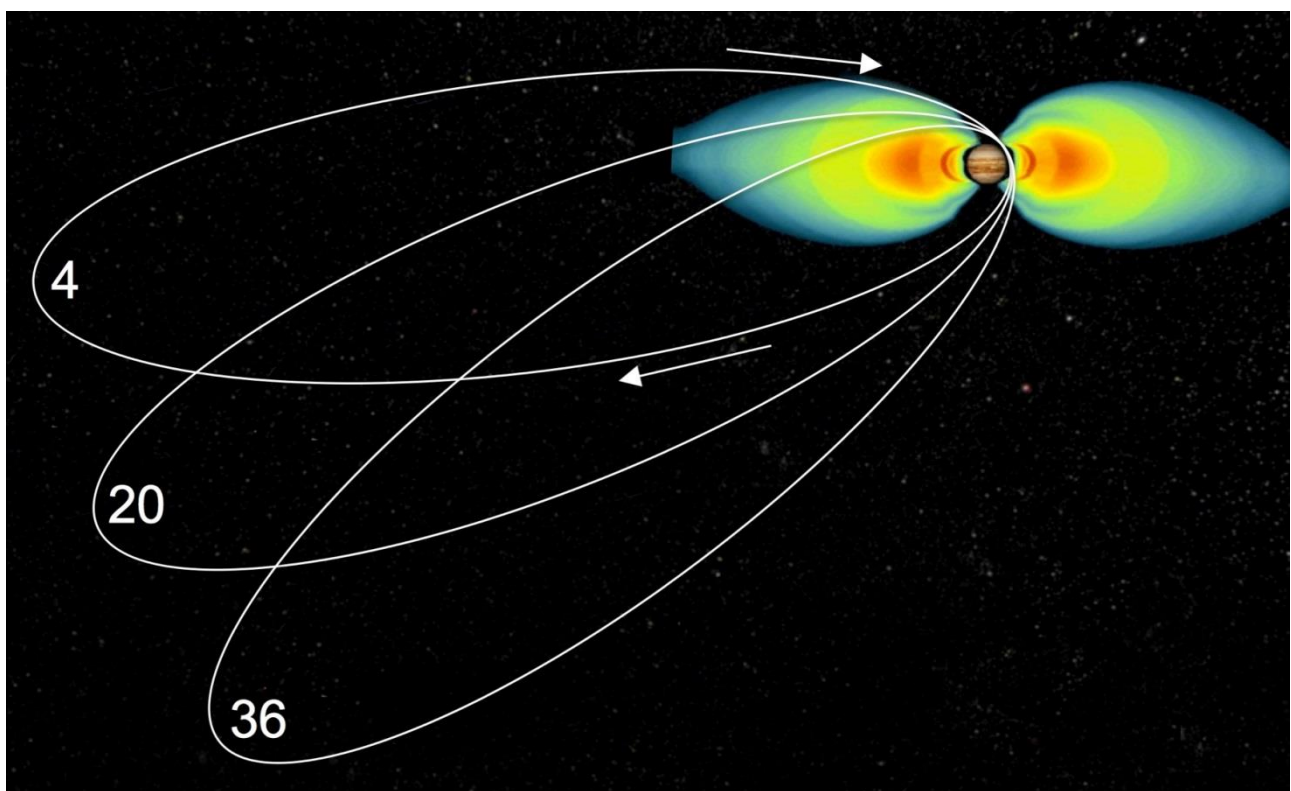
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Credit: NASA/GSFC/JPL-Caltech/DTU Space

The Magnetometer Investigation's star trackers (ASCs) on Juno spacecraft are collocated with the magnetometer sensors on a boom. Magnetometer optical bench allowed for limited radiation shielding of the cameras. In addition to suppressing the undesirable effects of penetrating energetic particles, the morphological filters in the instrument flight software provide a measurement of the actual penetrating flux at all times.



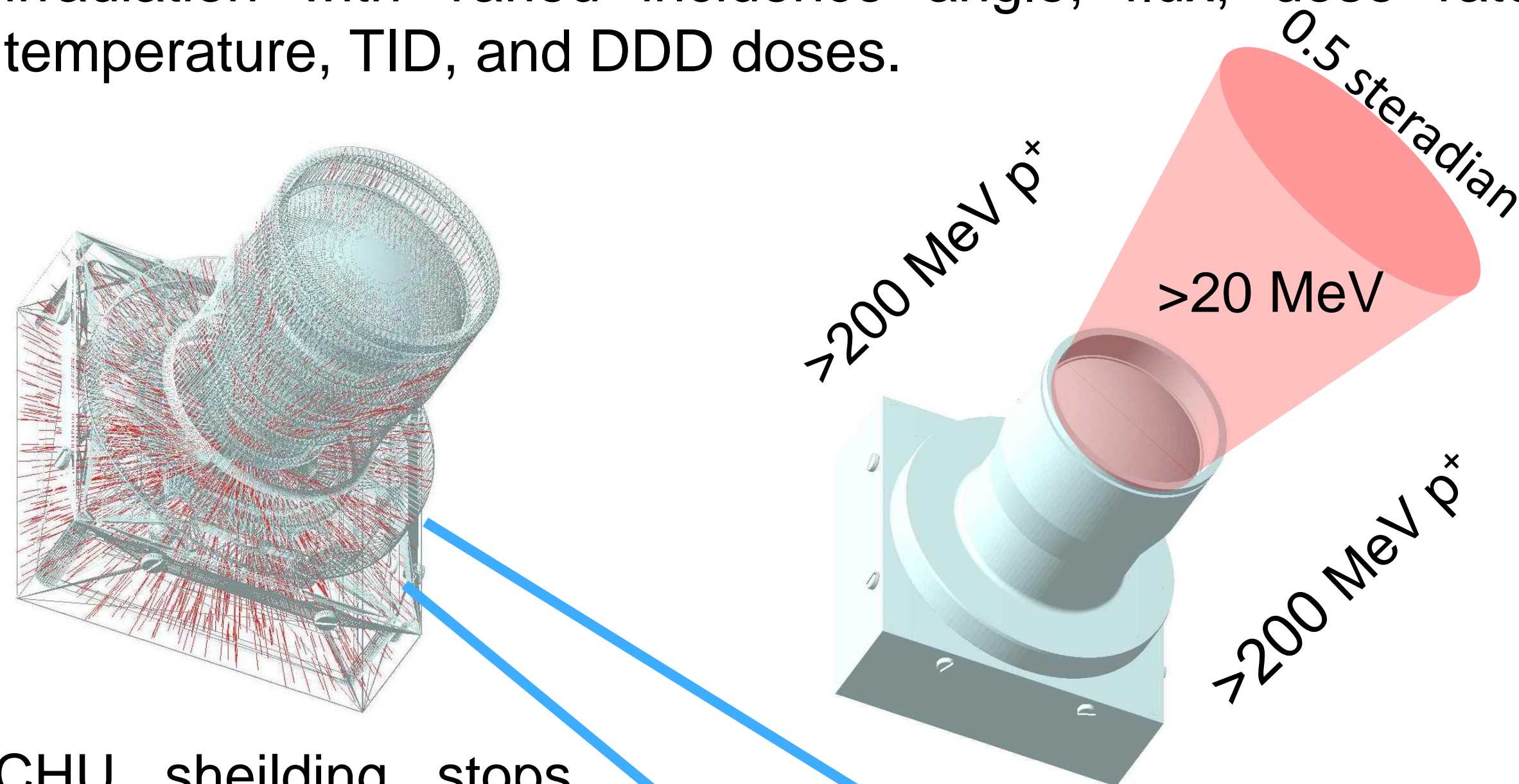
In addition to suppressing the undesirable effects of The ASC has profiled three distinct regions of high energy particle fluxes: the main plasma torus, the plasma populating the magnetic field lines reaching the auroral region, and, particle fluxes on near open field lines. We present a map of the regions profiled this far, and their associated fluxes, we show the high energy fluxes observed on field lines connecting to the Jovian satellites, and we discuss the particle nature observed on open field lines.

micro Advanced Stellar Compass μ ASC

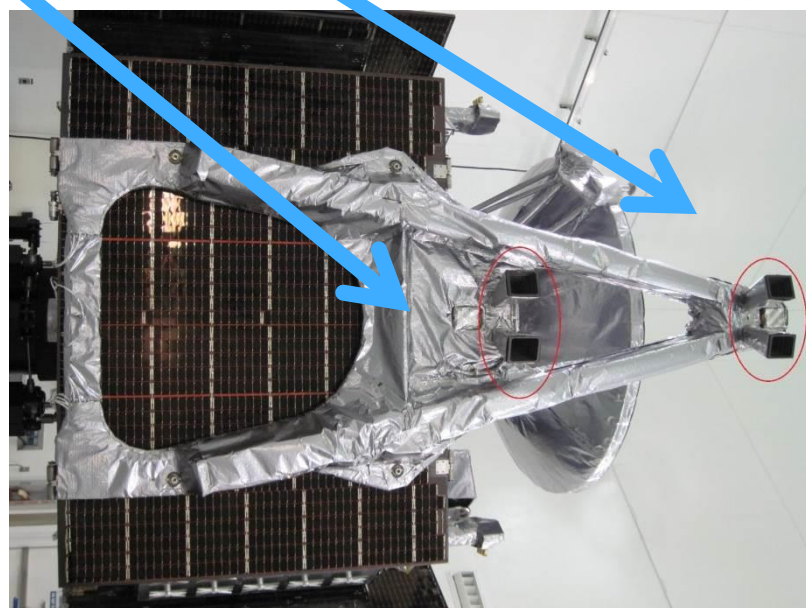
- Designed and produced by the Measurement and Instrumentation Systems (DTU)
- one of the most successful star tracker worldwide
- autonomously calculates attitude based on all bright stars in the CHUs Field of View
- provides 22 true solutions per second with one single CHU
- absolute accuracy of < 1 arc second
- operating on many satellite missions without a single hardware or functional failure

Calibration

The μ ASC response to the high energy irradiation is fully calibrated using 1-2 MeV electron and 30-200 MeV proton irradiation with varied incidence angle, flux, dose rate, temperature, TID, and DDD doses.



CHU shielding stops all e^- <20 MeV



Calibrating images acquired during irradiation with high flux of electrons (left) and heavies (right).

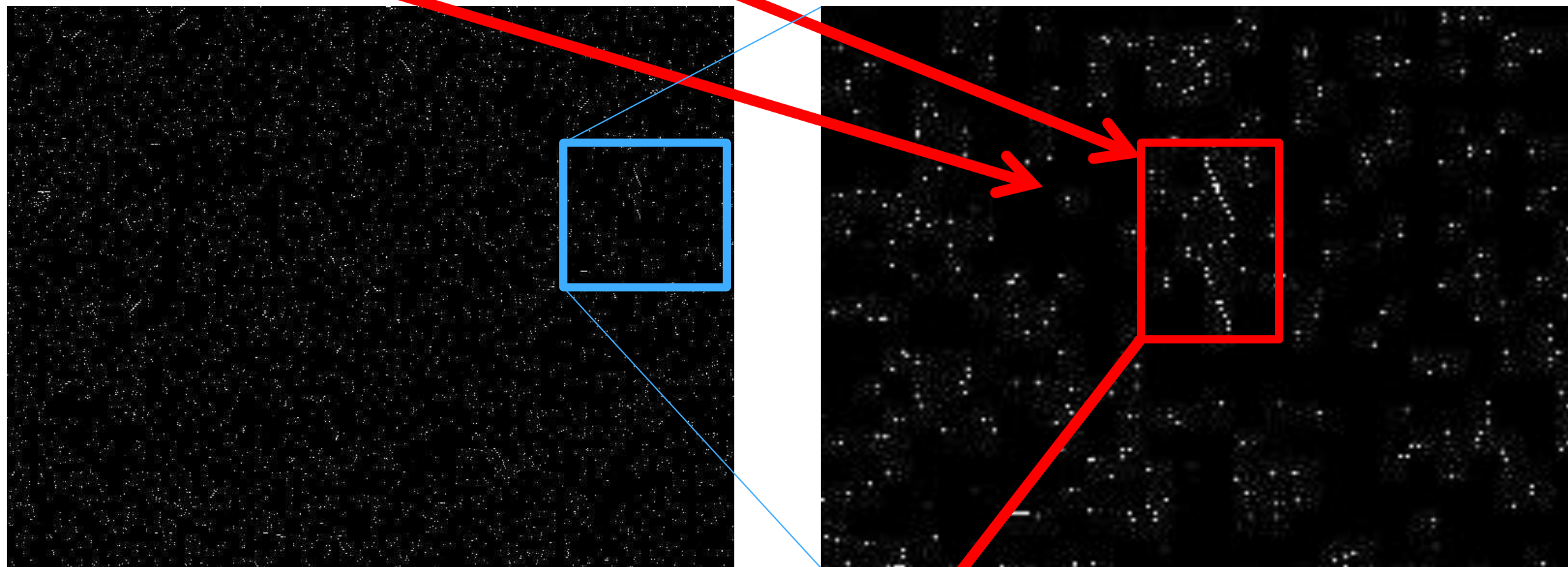


Image analysis. Deposited energy

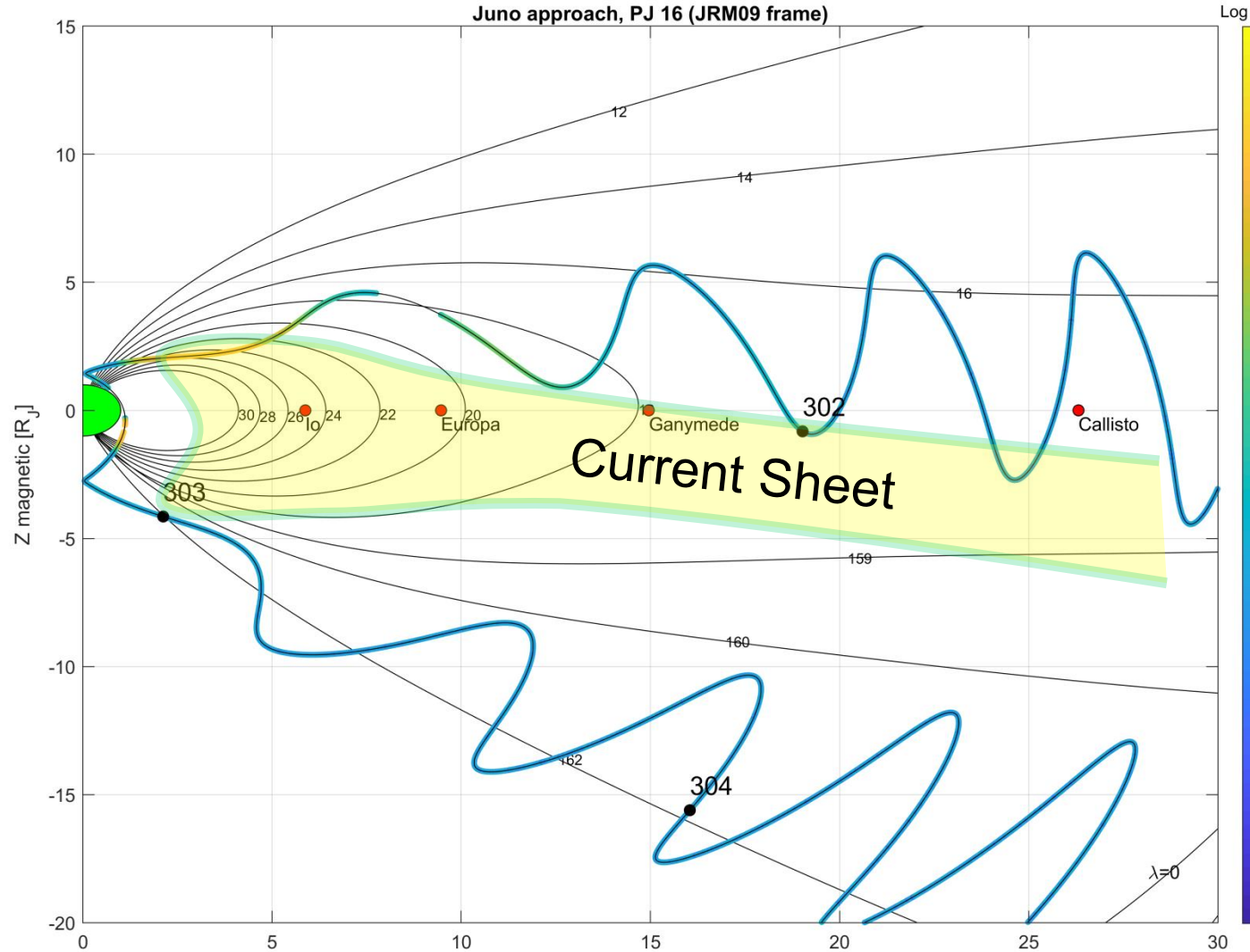
A track left by an energetic particle that hit the CCD is ~50 pixels long (~0.7 mm or 160 mg/cm²) and has 4 or 5 splits due to recoil nuclei produced by the incident particle in silicon. Estimation of the primary energy of a particle that could traverse at least 0.7 mm in Si behind the heavy shielding will involve the transport flux modelling for the μ ASC, the calibration curves of the CCD and inflight image analysis.



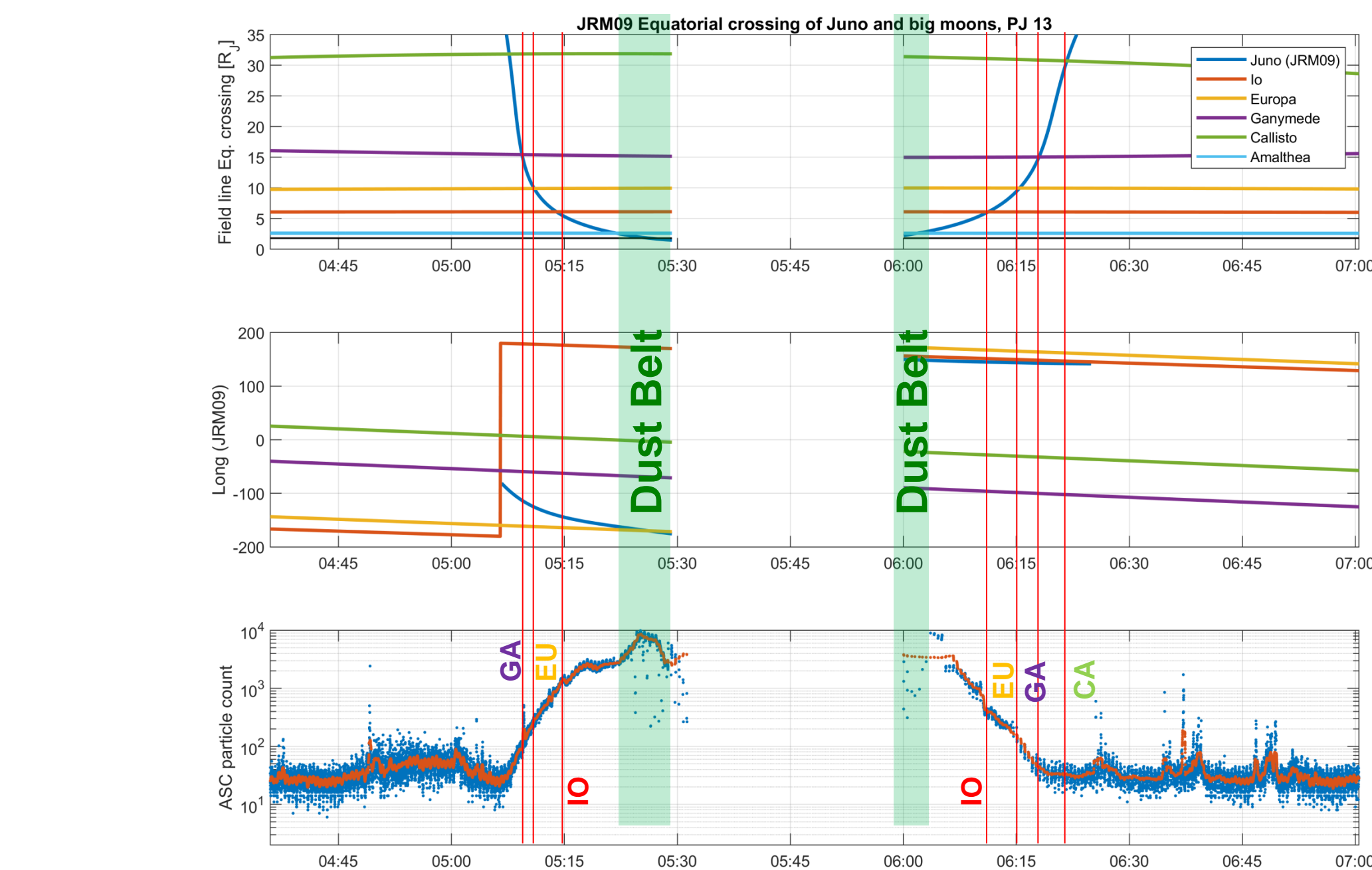
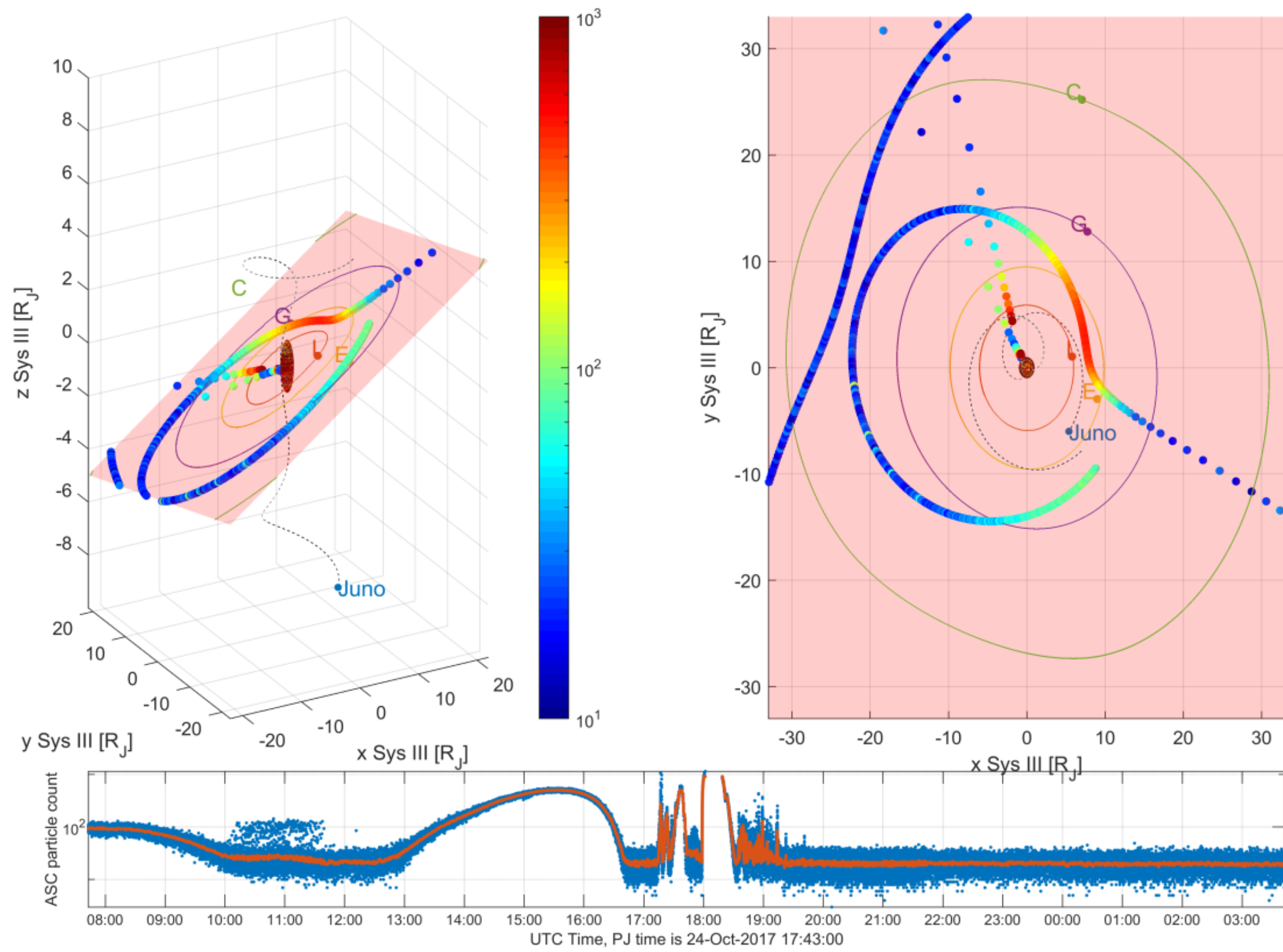
Heavy particle with incoming $E \gg 85\text{MeV}$

Observations

The wiggle plot below shows Juno's position in magnetic coordinates (Rho, Z) in [R_J]. In the trace of the orbit, the flux measured by the μ ASC is displayed with a color scale. The major Jovian moons radial distance have been also added in the plot in addition to the model of the magnetodisc.

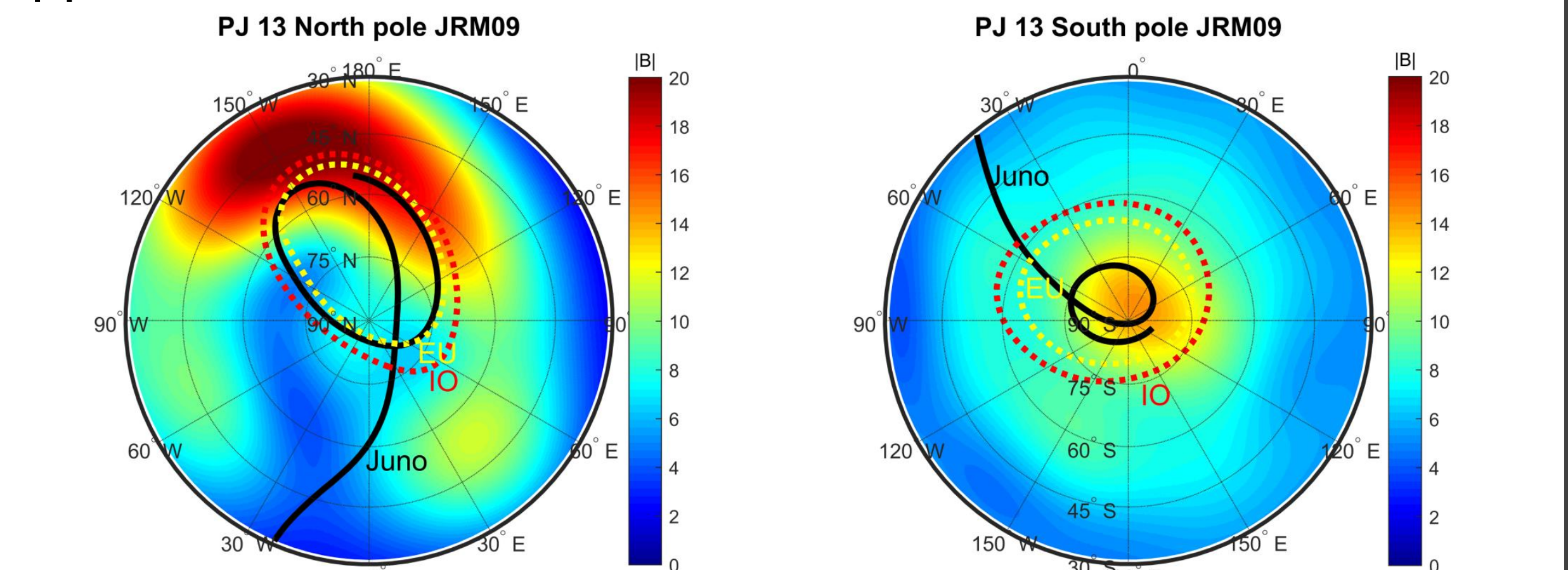


Juno's crossing of the magnetic field lines which intersect the Jovian moon orbits is shown. These crossings are correlated with observations of the μ ASC particle counter.

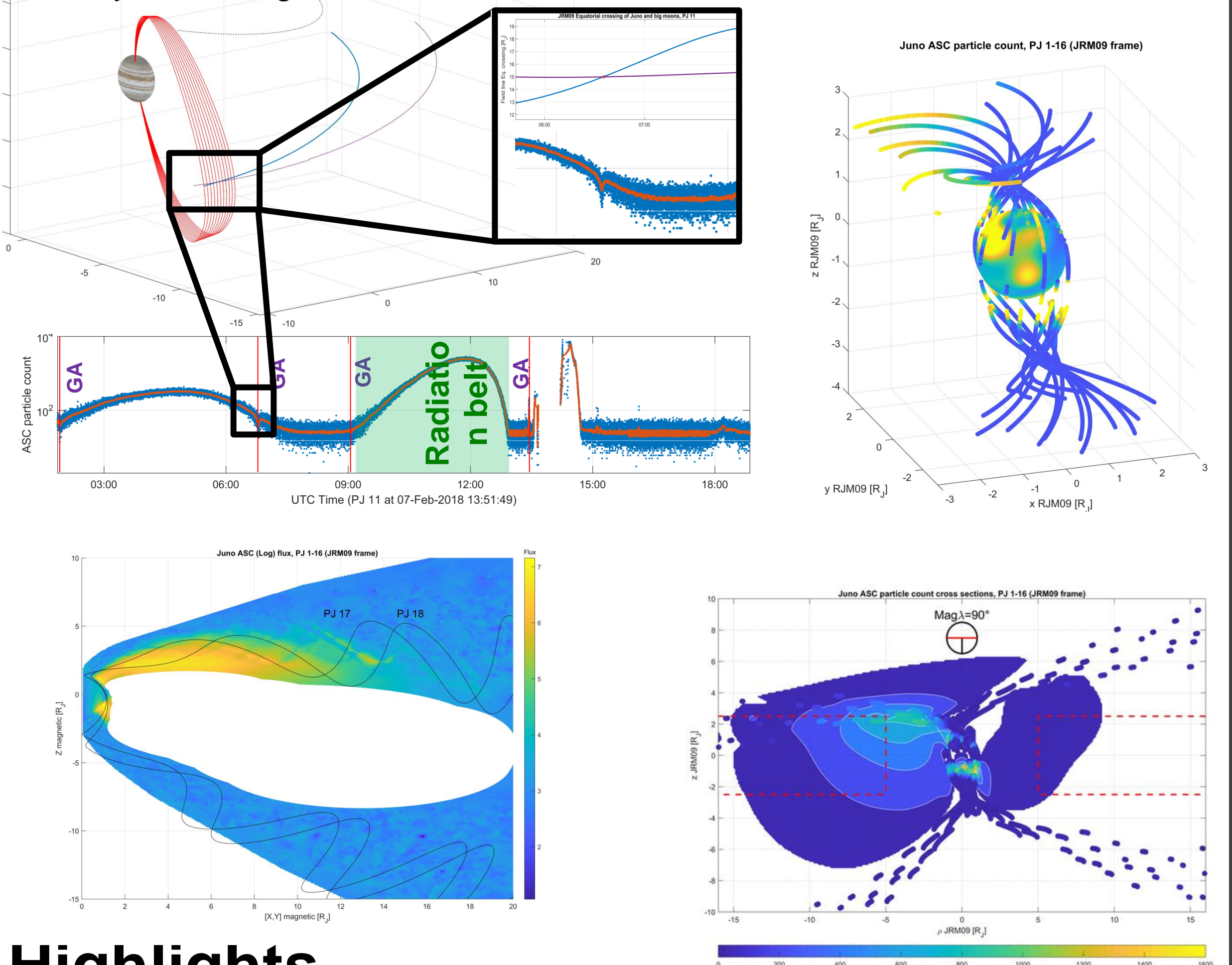


Jovian magnetic field

Jupiter's magnetic field model (JRM09) by Connerney (2018) describes the field with spherical harmonics up to degree 10. It is based on measurements performed near Jupiter by the Juno mission. The JRM09 model shows a more complex Jovian magnetic field in comparison to earlier models (eg. VIP4), and a clear asymmetry within the northern and southern hemispheres. For larger distances to the planet (>10 R_J), the magnetic field can be represented well by a 10.5° tilted magnetic dipole and there is no apparent differences wrt VIP4 model.



Ganymede diameter: 5282km
Ganymede magnetic disturbance width: ~8600km



Highlights

- Model of the high energy electron radiation environment near the
- Better constrains on the Jupiter's current sheet
- Magnetic footprint of the Jupiter's inner planet

Ref.: Jørgensen, P. S., Jørgensen, J. L., & Denver, T. 2004. *μAsc: a miniature star tracker*, Proceedings of The 4S Symposium: Small Satellites, Systems and Services (ESA SP-571). 20 - 24 September 2004, La Rochelle, France. Editor: B. Warmbein. Published on CDROM., id.55.1, 2004ESASP.571E..55J